Key feature of the presented switching method: in normal operating conditions each TF is switched immediately. In particular conditions, e.g., protection, (some) TFs are delayed.

The frequency of the selected time reference is recovered and this is enough to work properly without slips. The phase can be recovered if the link length is known.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

WHAT IS CLAIMED IS:

1. A transmission system for coupling of data units from an output port to an input port of a communications channel, the system comprising:

a Coordinated Universal Time (UTC) signal providing a common time reference (CTR); wherein the CTR is coupled to a transmitter subsystem and a receiver subsystem;

a source of delimiter signals responsive to the CTR;

wherein the transmitter subsystem, responsive to the delimiter signals and the CTR for sending control information and data units over the communications channel; and

wherein the receiver subsystem physically separate from the transmitter subsystem wherein the receiver subsystem is responsive to selected ones of the delimiter signals and the CTR, for storing the received data units from the communications channel.

2. The system as in Claim 1, wherein the CTR is comprised of a plurality of contiguous time frames.

3. The system as in Claim 2, wherein for at least one of the plurality of the contiguous time frames, a beginning of the time frame is signaled by a respective time frame delimiter signal.

4. The system as in Claim 3, wherein the control information is comprised of a respective time frame delimiter .

5. The system as in Claim 3, wherein for at least one of the plurality of contiguous time frames, a first data unit of a time frame is signaled by a time frame delimiter.

6. The system as in Claim 5, wherein a respective one of the time frames is associated with the sending of the data units, the system further comprising:

an alignment subsystem responsive to the time frame delimiter, and to the received data units, to store each of the respective received data units mapped according to the respective one of the time frames associated with the sending of the respective received data units.

7. The system as in Claim 6, wherein the alignment subsystem is comprised of a plurality of queue buffers;

wherein each of the queue buffers stores respective ones of the data units received during respective ones of the time frames.

8. The system as in Claim 7, wherein the data units are forwarded out of respective ones of the queue buffers responsive to the CTR.

9. The system as in Claim 1, wherein the CTR is comprised of a plurality of contiguous time frames with a plurality of predefined time durations.

10. The system as in Claim 9, wherein the sent control information is associated with at least one of the plurality of the contiguous time frames,

wherein the control information is comprised of a time frame delimiter; and

wherein the time frame delimiter signals a beginning of the respective time frame.

11. The system as in Claim 3, wherein the control information is comprised of a time stamp.

12. The system as in Claim 3, wherein the time frame delimiter signal is a safety margin, wherein no data units and control information are transmitted.

13. The system as in Claim 3, wherein the beginning of the time frame is signaled by counting the transmitted data units.

14. The system as in Claim 7, wherein groupings of the contiguous time frames form a time cycle, wherein there are a plurality of contiguous time cycles.

15. The system as in Claim 14, wherein at least once during each of the time cycles, one of the time frames is a control time frame communicating control data.

16. The system as in Claim 15, wherein at least one of the queue buffers is a control queue buffer for storing the control data.

17. The system as in Claim 15, wherein the control time frame is identified responsive to a control time frame delimiter.

18. The system as in Claim 17, wherein the control time frame delimiter is comprised within control information.

19. The system as in Claim 15, wherein the time frame delimiter is comprised of a time stamp.

20. The system as in Claim 19, wherein a respective one of the time frames is associated with the sending of the data units;

wherein the alignment subsystem responsive to the time frame delimiter, and to the received data units, stores each of the received data units mapped according to the respective time frame associated with the sending of the respective data units; wherein a specific one of the queue buffers is selected responsive to the respective time stamp and the CTR.

21. The system as in Claim 20, wherein there is an expected delay between the sending of the data units and the receiving of the data units and control signals, wherein when an actual delay exceeds the expected delay by a first defined time, the alignment subsystem delays output from the respective queue for a second defined time responsive to the time stamp and the CTR.

22. The system as in Claim 21, wherein the time cycle has a defined duration, wherein the second defined time equals the defined duration minus the first defined time.

23. The system as in Claim 1,

wherein the control information is encoded using fiber channel control codewords.

24. The system as in Claim 1,

wherein the control information encoded using at least one of a SONET transport overhead and a SONET path overhead.

25. The system as in Claim 1,

wherein the control information is encoded using Digital Wrapper framing.

26. The system as in Claim 1,

wherein the control information is encoded using at least one of an IP data packet, an ICMP message, an ATM cell, a PPP frame, an HDLC frame, and an LCP message.

27. The system as in Claim 1,

wherein the data units are comprised of a header; and

wherein the control information is encoded using at least one of a plurality of selected fields in the header, wherein the data units are at least one of an IP data packet, an ATM cell, a PPP frame, and an HDLC frame.

28. A transmission system for coupling of data units from an output port to an input port of a communications channel, the system comprising:

a Coordinated Universal Time (UTC) signal providing a common time reference (CTR);

a source of time frame safety gaps responsive to the CTR;

a transmitter subsystem, responsive to delimiter signals and the CTR for sending safety gaps, control information and data units over the communications channel;

a receiver subsystem physically separate from the transmitter subsystem; and

wherein the received subsystem is responsive to selected ones of the safety gaps and the CTR, for storing the received data units from the communications channel.

29. The system as in Claim 28, wherein the CTR is comprised of a plurality of time frames.

30. The system as in Claim 29, wherein for at least one of the plurality of the time frames, a beginning of the time frame is signaled by a respective safety gap.

31. The system as in Claim 30, wherein the respective safety gap is part of the control information.

32. The system as in Claim 29, wherein for at least one of the plurality of time frames, a first data unit of a time frame is signaled by a safety gap.

33. The system as in Claim 32, wherein a respective one of the time frames is associated with the sending of the data units, the system further comprising:

an alignment subsystem responsive to the safety gaps, to delay each of the respective data units mapped according to the respective one of the time frames associated with the sending of the respective received data units.

34. The system as in Claim 33, wherein the alignment subsystem is comprised of at least one programmable delay line;

wherein each of the programmable delay lines selectively delays respective ones of the data units received during respective ones of the time frames.

35. The system as in Claim 34, wherein the programmable delay line is an optical delay line.

36. A transmission method for coupling of data units from an output port to an input port of a communications channel, the method comprising:

providing a Coordinated Universal Time (UTC) signal as a common time reference (CTR);

a source of delimiter signals responsive to the CTR;

a transmitter subsystem, responsive to the delimiter signals and the CTR for sending control signals and data units over the communications channel; and

a receiver subsystem physically separate from the transmitter subsystem wherein the receiver subsystem is responsive to a selected one of the delimiter signals and the CTR, for storing the received data units from the communications channel.

37. The method as in Claim 36, further comprising the CTR

dividing into a plurality of contiguous time frames.

38. The method as in Claim 37, further comprising:

signaling a beginning of the time frame as a respective time frame delimiter signal for at least one of the plurality of the contiguous time frames; and

providing the respective time frame delimiter signal is one of the control signals.

39. The method as in Claim 37, further comprising: signaling a first data unit of a time frame by a time frame delimiter signal for at least one of the plurality of contiguous time frames.

40. The method as in Claim 39, further comprising:

associating a respective one of the time frames with the sending of the data units; and

storing each of the respective received data units mapped according to the respective one of the time frames associated with the sending of the respective received data units, responsive to the time frame delimiter, and to the received data units, to store each of the respective received data units.

41. The method as in Claim 40, further comprising:

storing respective ones of the data units received during respective ones of the time frames in each of a plurality of queue buffers; and

storing respective ones of the data units received during respective ones of the time frames.

42. The method as in Claim 41, further comprising:

forwarding data units out of respective ones of the queue buffers responsive to the CTR.

43. The method as in Claim 38, wherein the time frame delimiter is comprised of a time stamp.

44. The method as in Claim 38, wherein the time frame delimiter proves is a safety margin wherein no data units and control signals are transmitted.

45. The method as in Claim 38, further comprising:

signaling the beginning of the time frame responsive to counting the transmitted data units.

46. A transmission method for coupling of data units from an output port to an input port of a communications channel, the method comprising:

providing a common time reference (CTR) comprising a Coordinated Universal Time (UTC) signal;

generating a source of time frame safety gaps responsive to the CTR;

sending control signals and data units over the communications channel responsive to the safety gaps and the CTR; and

a physically separate receiver subsystem for storing the received data units from the communications channel responsive to a selected one of the safety gaps and the CTR.

47. The system as in Claim 46, wherein the CTR is comprised of a plurality of time frames.

48. The system as in Claim 47, further comprising:

signaling for at least one of the plurality of the time frames, a beginning of the time frame, as a respective time frame safety gap.